12-13-2016

Webinar: State-Wide Pedestrian and Bicycle Miles Traveled: Can We Estimate It?

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State-wide Pedestrian and Bicycle Miles Traveled: Can we estimate it?

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WSDOT

Portland State UNIVERSITY

Mike Sellinger, MURP, Alta Planning & Design

Taylor Phillips, Portland Bureau of Transportation

NITC NATIONAL INSTITUTE for TRANSPORTATION and COMMUNITIES

Overview

- Purpose
- Review
- Data
- Methods
- Results
- Conclusions & Recommendations

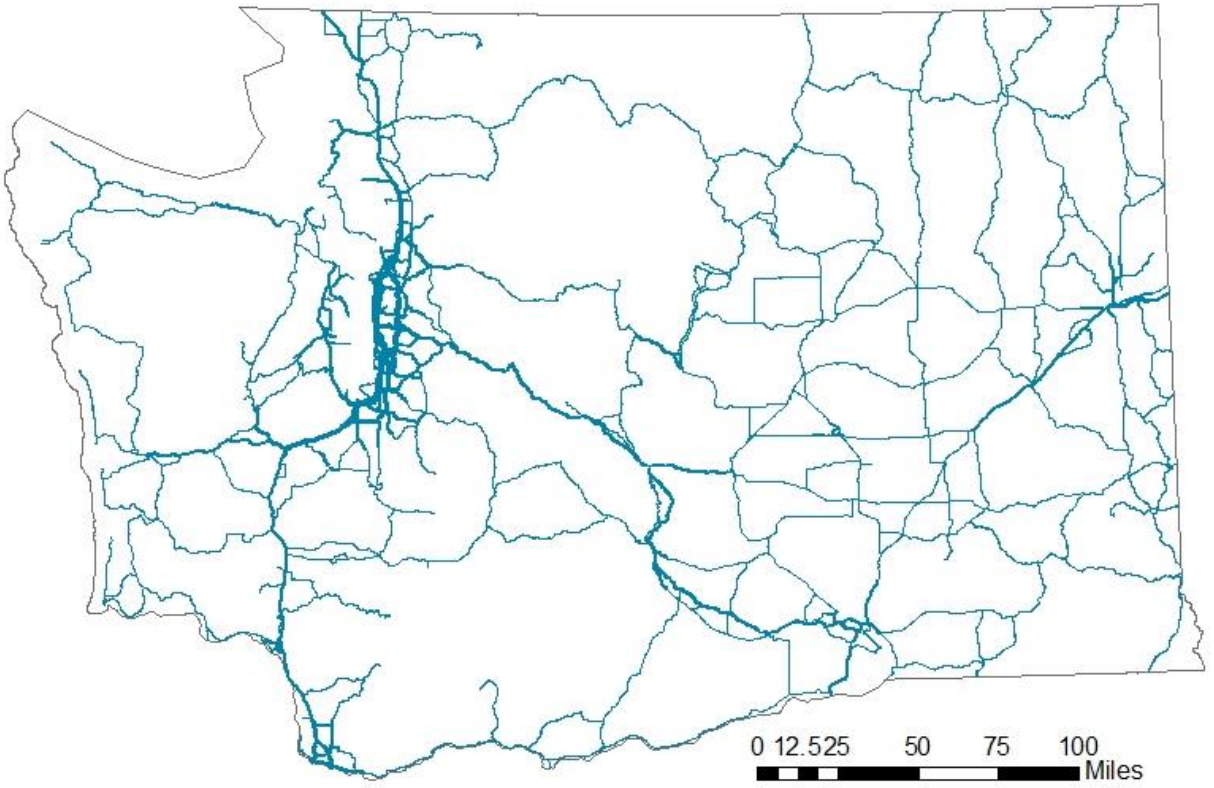
PURPOSE

Why measure walking & biking?

Purpose	Facility Level	City Level	State level
Funding & policy decisions (Performance measures)	✓	✓	✓
To show change over time	✓	✓	✓
Facility design	✓		
Economic impact	✓	✓	
Public health		✓	✓
Safety	✓	✓	✓

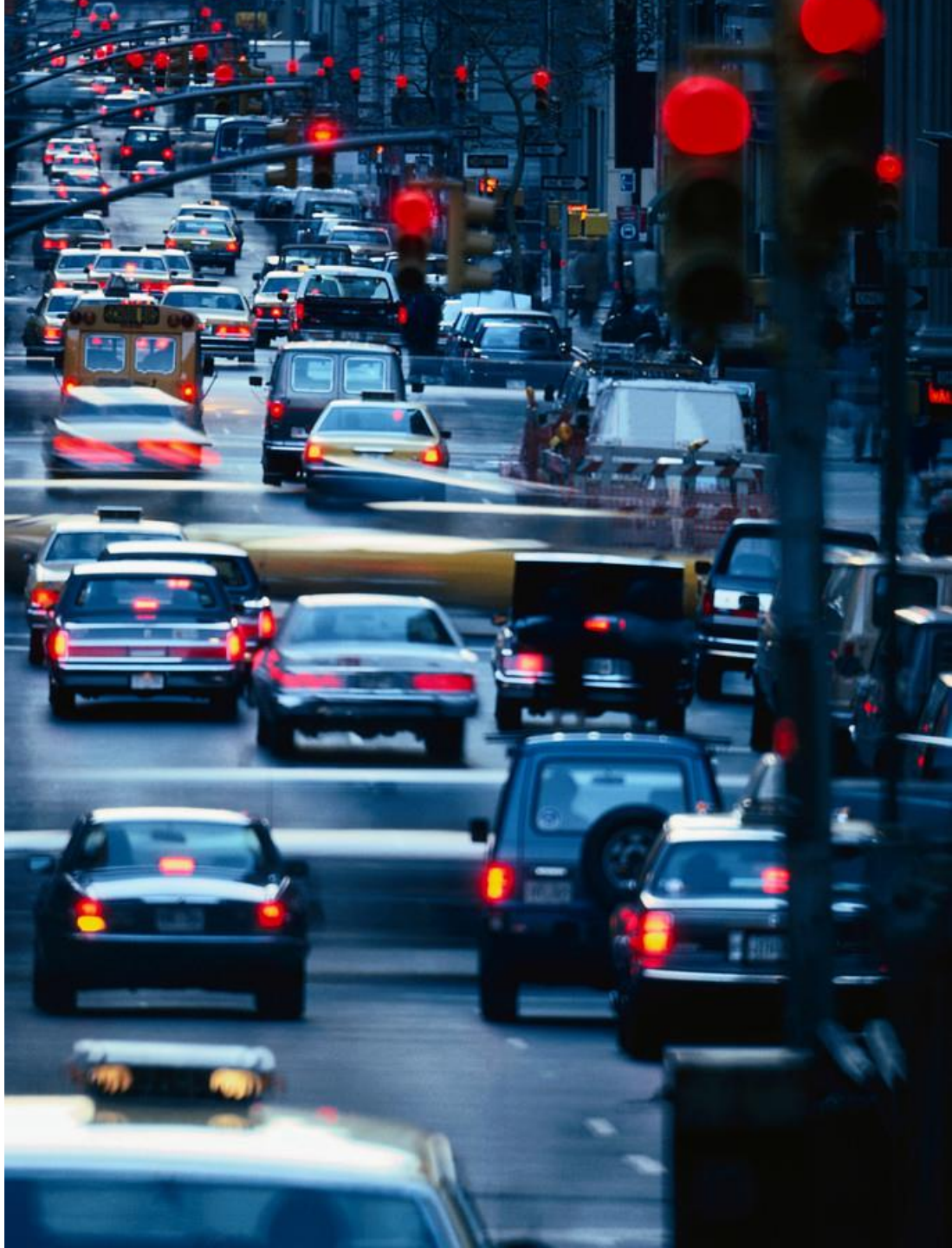
BMT and PMT

- Bicycle Miles Traveled (BMT)
- Pedestrian Miles Traveled (PMT)



REVIEW

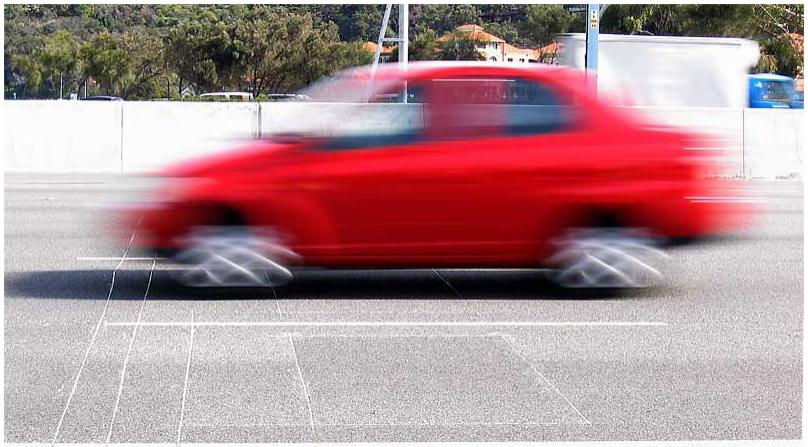
TRAFFIC MONITORING PROGRAMS



State Traffic Monitoring

Permanent Counters

Commonly inductive loops

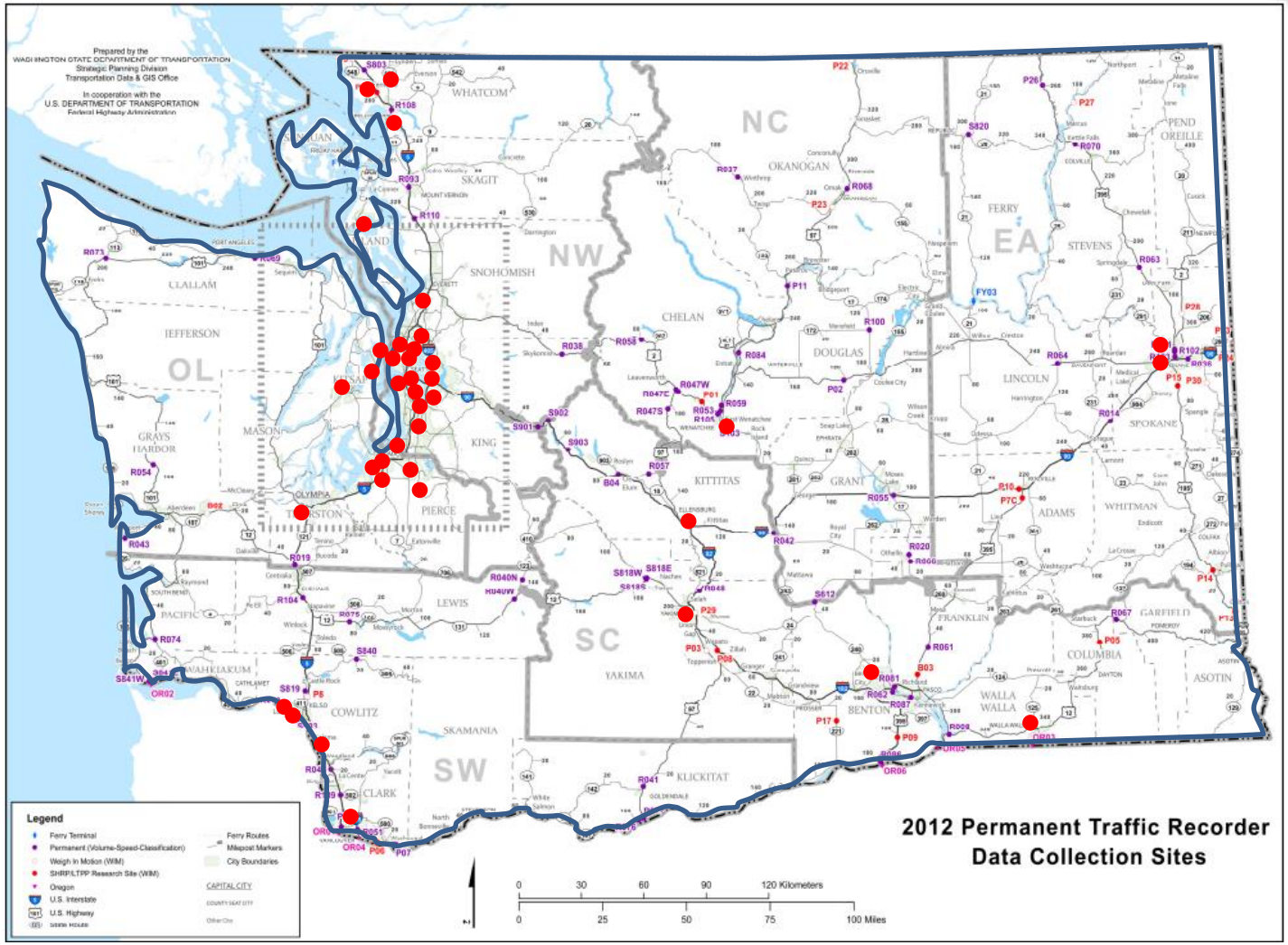


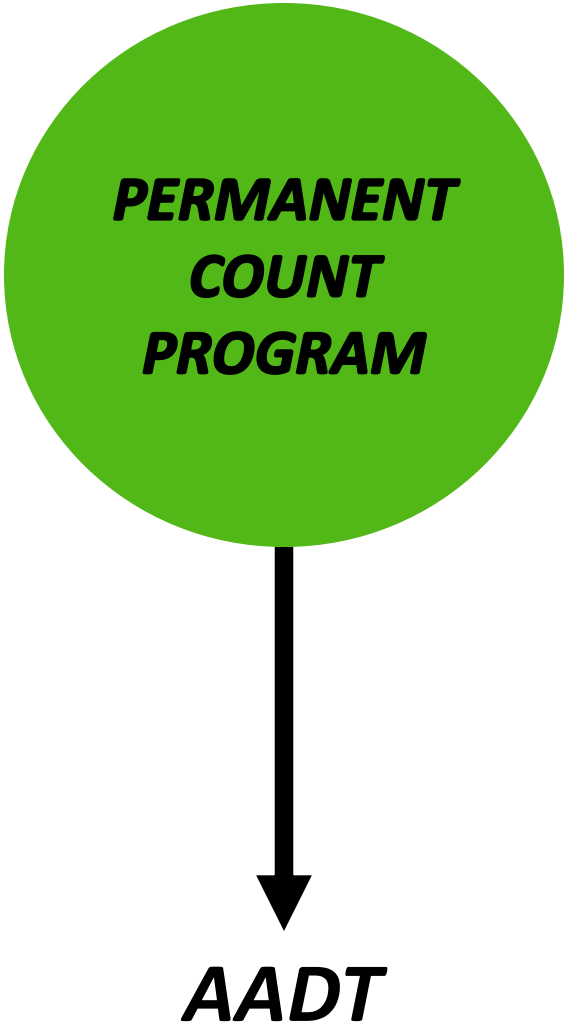
Metro Count Accessed 6/13/13 http://mtehelp.tech-metrocount.com/article.aspx?key=mc5805

Short Duration Counters

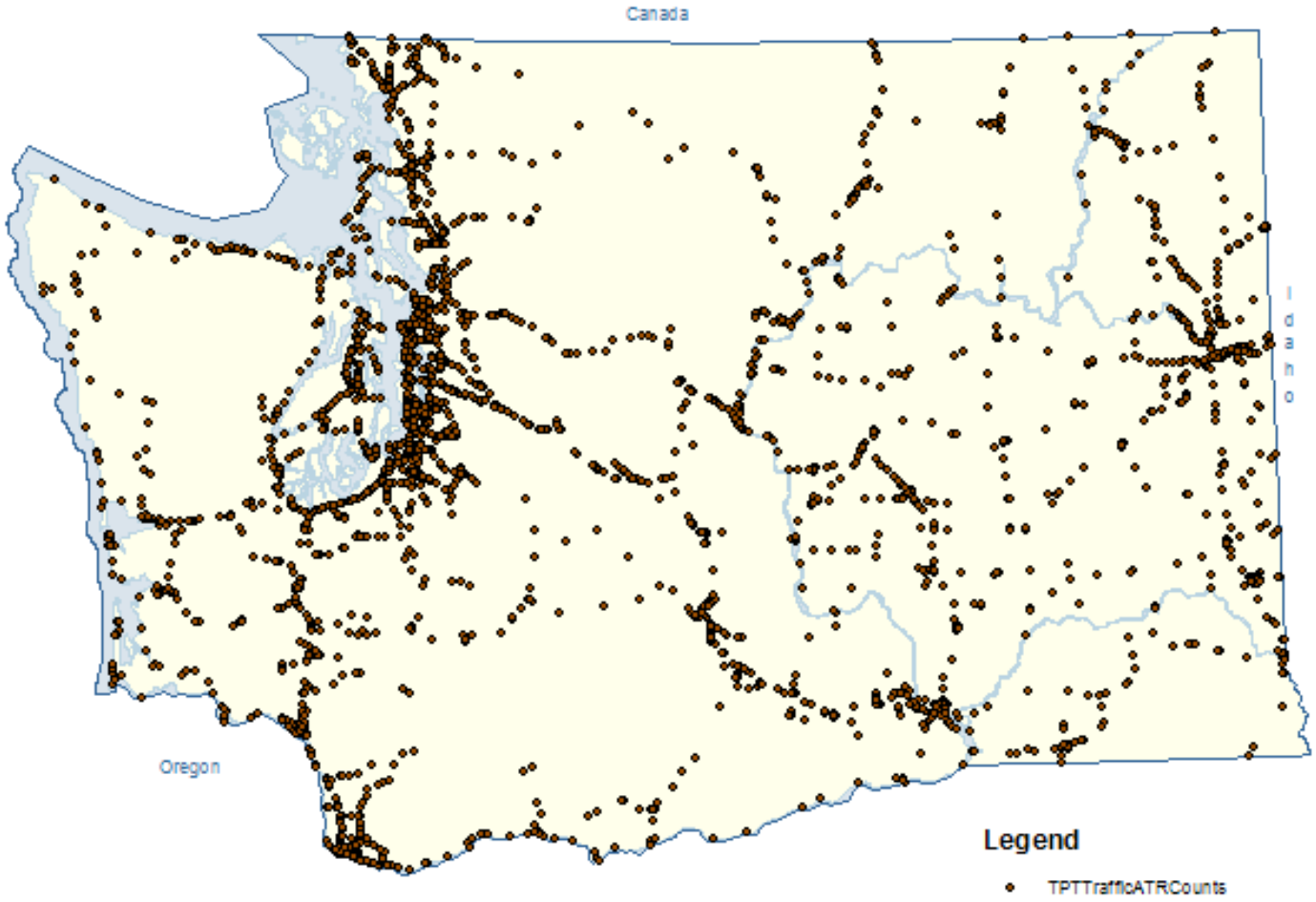
Commonly pneumatic tubes

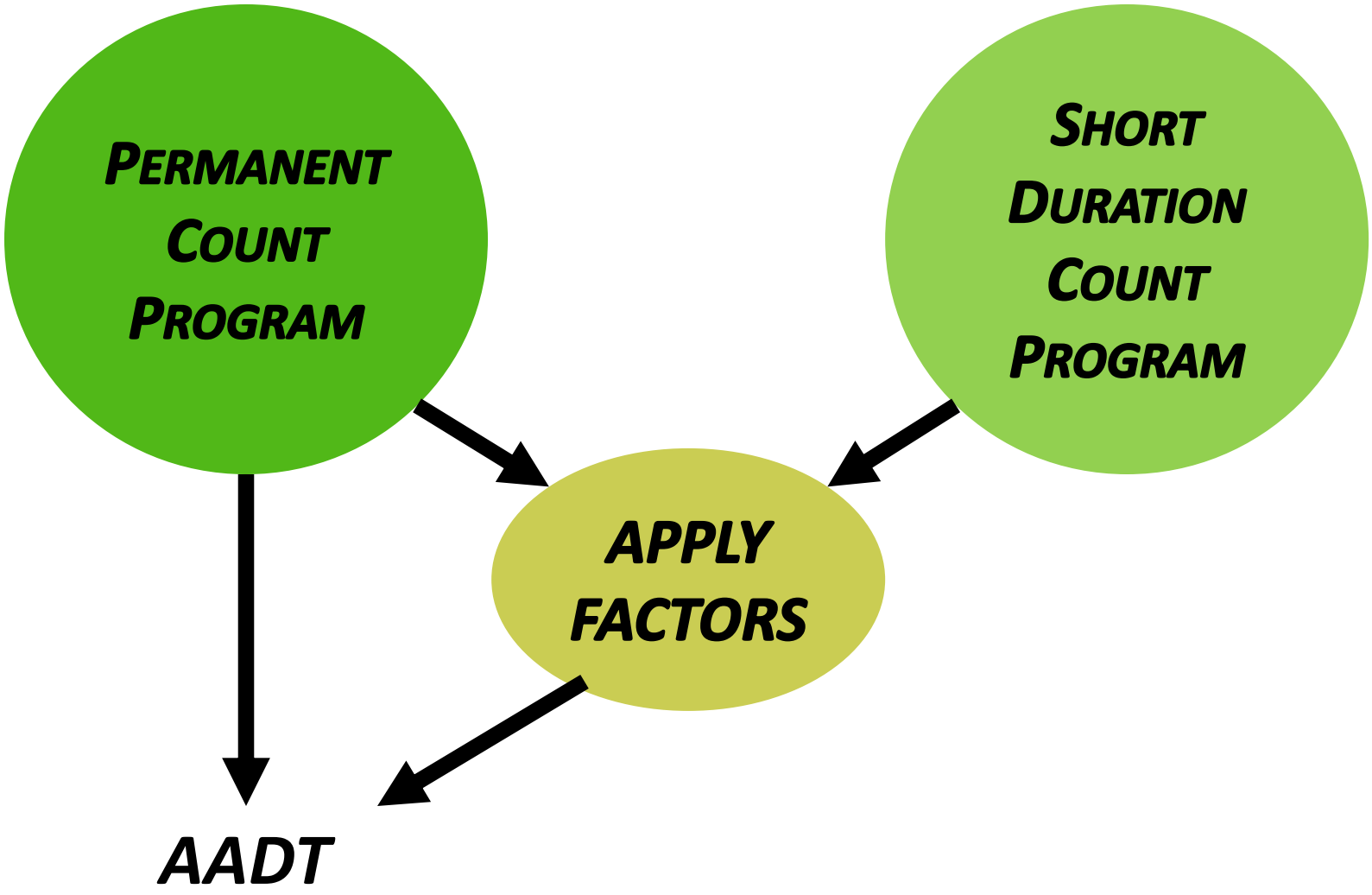
Permanent Counters



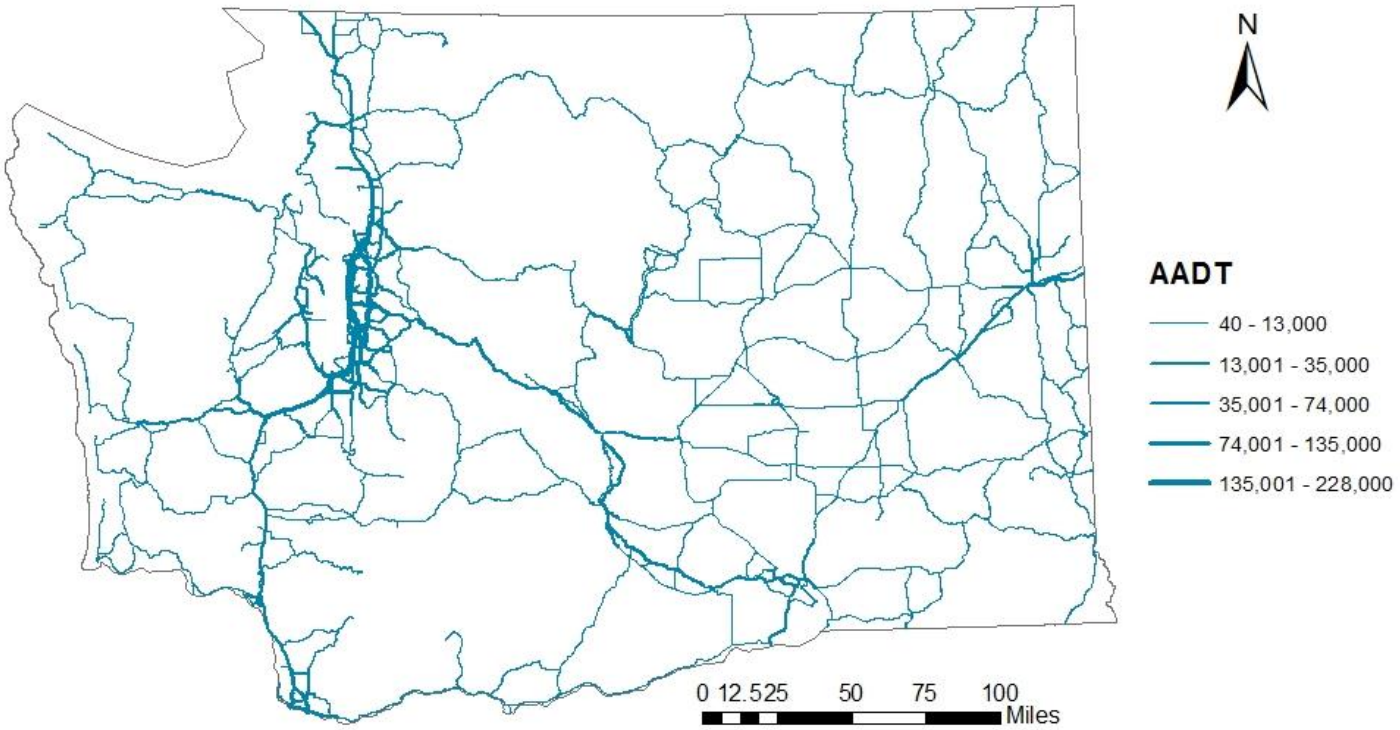

PERMANENT
COUNT
PROGRAM
AADT

Short Duration Counters




PERMANENT COUNT PROGRAM
SHORT DURATION COUNT PROGRAM
APPLY FACTORS
AADT

AADT and VMT



Sum (AADT X Segment Length) over network to compute Vehicle Miles Traveled (VMT)

Can we apply these methods to biking and walking?

Acronyms

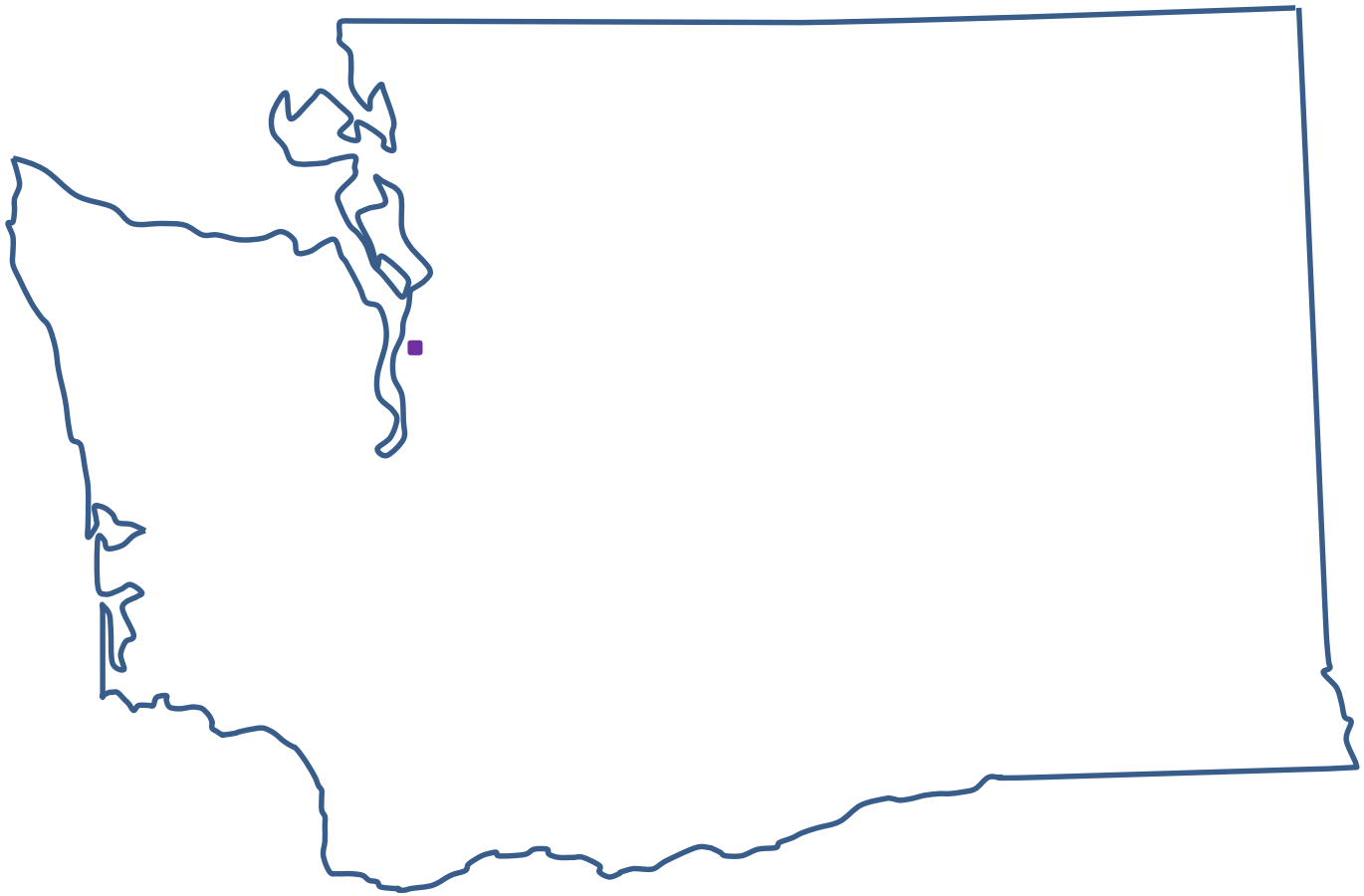
AADBT=Annual Average Daily Bicycle Traffic

AADPT= Annual Average Daily Pedestrian Traffic

AADNT = Annual Average Daily Non-motorized Traffic

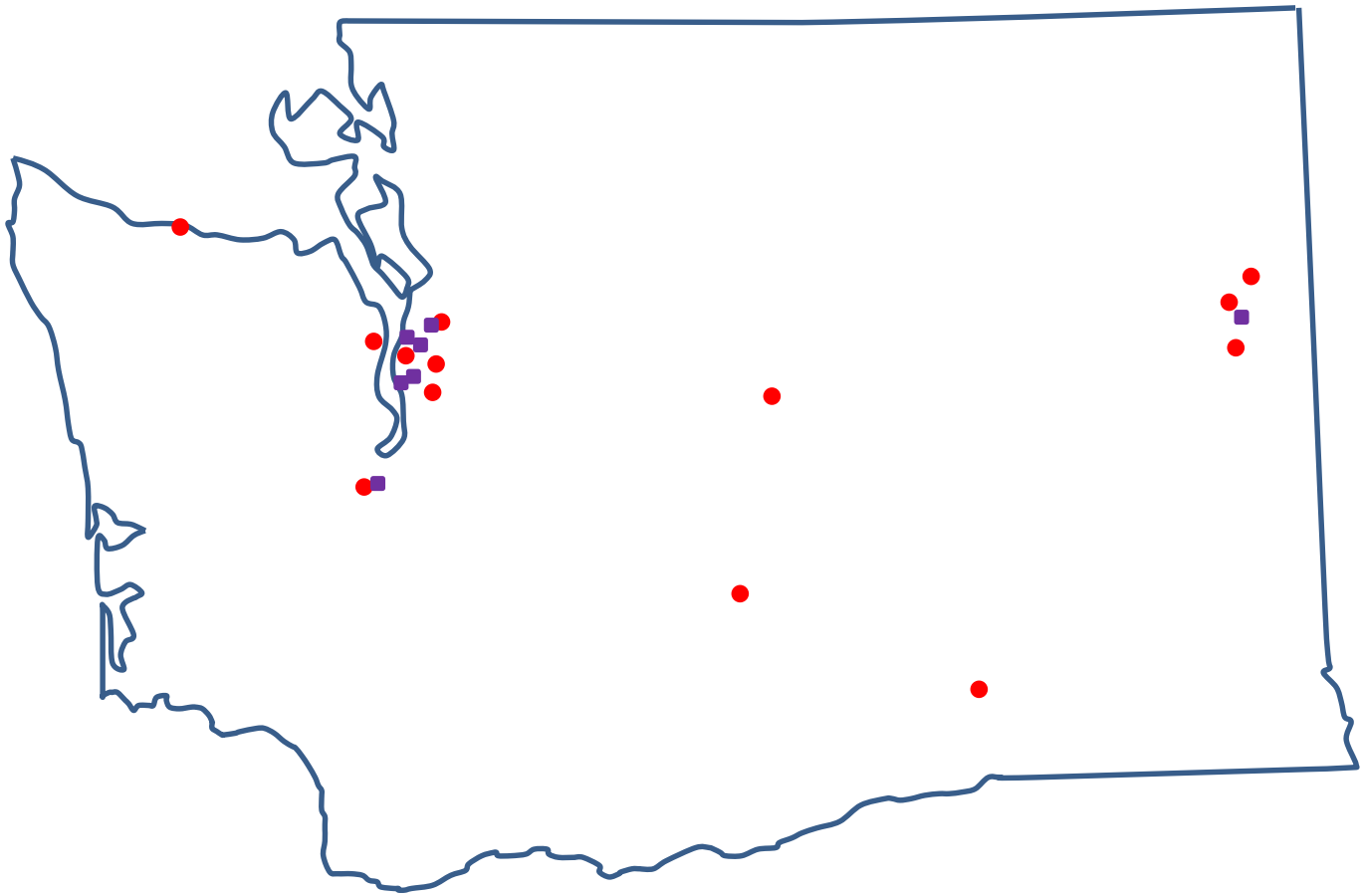
DATA

Permanent Counters in 2012



- Bicycle Counter

WSDOT Permanent Counters 2016

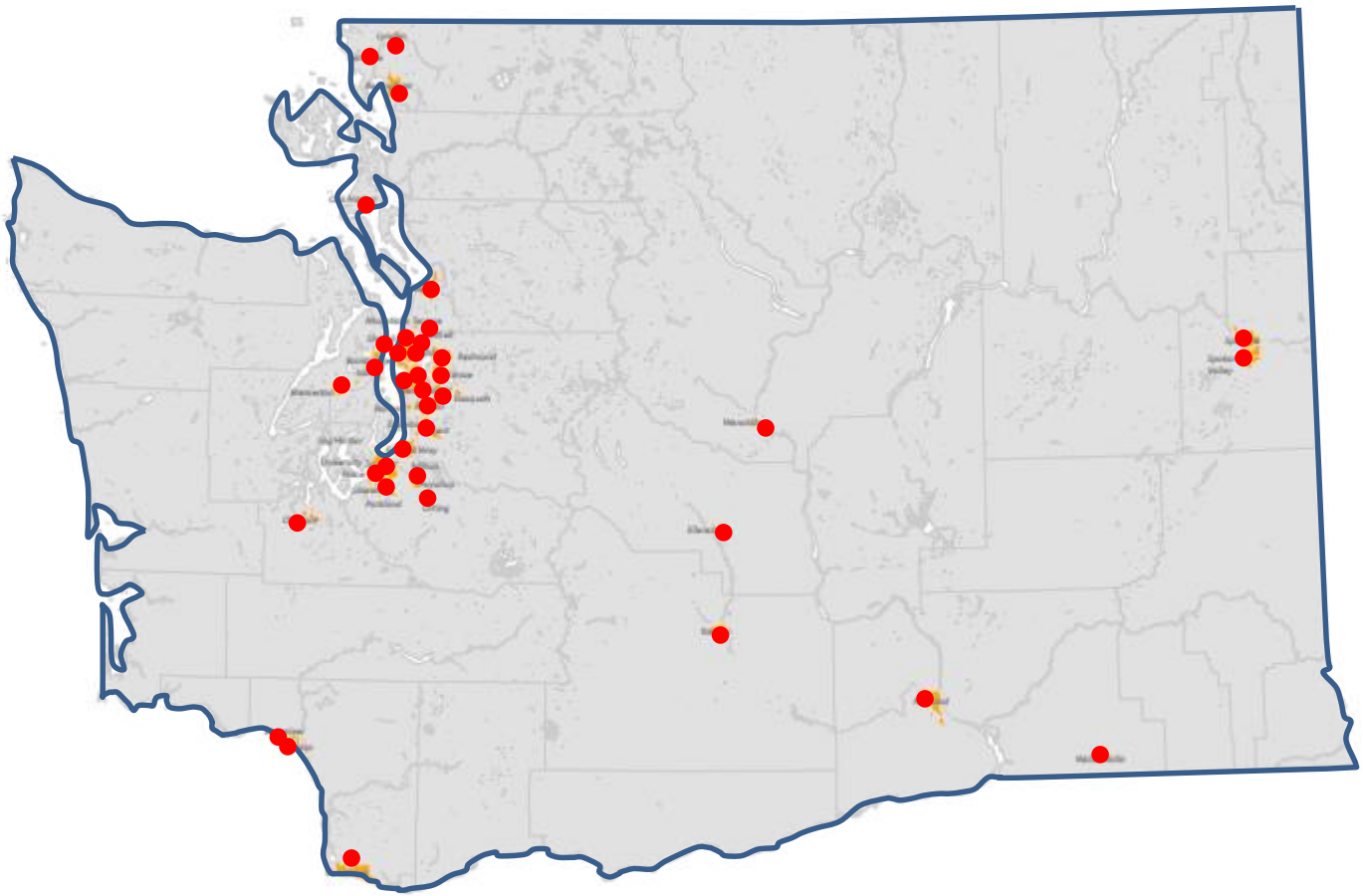


- Bicycle Counter
- Bicycle and Pedestrian Counter

http://wsdot.wa.gov/data/tools/bikepedcounts/

Short Duration Counts

2012 Washington State Bicycle and Pedestrian Documentation Project

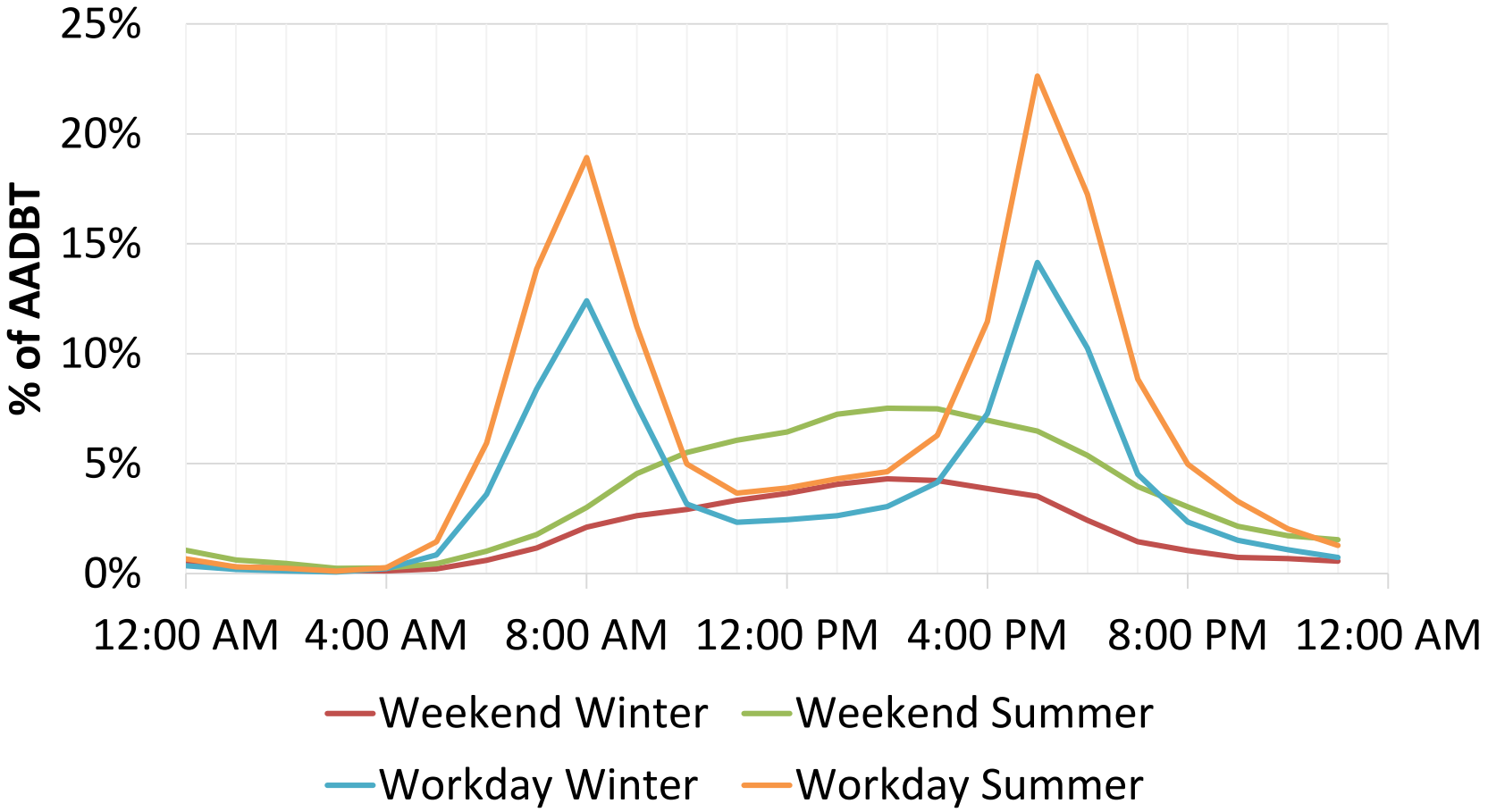


Annual Sept/Oct, volunteer manual counts, morning and evening peak hours

Traffic Patterns

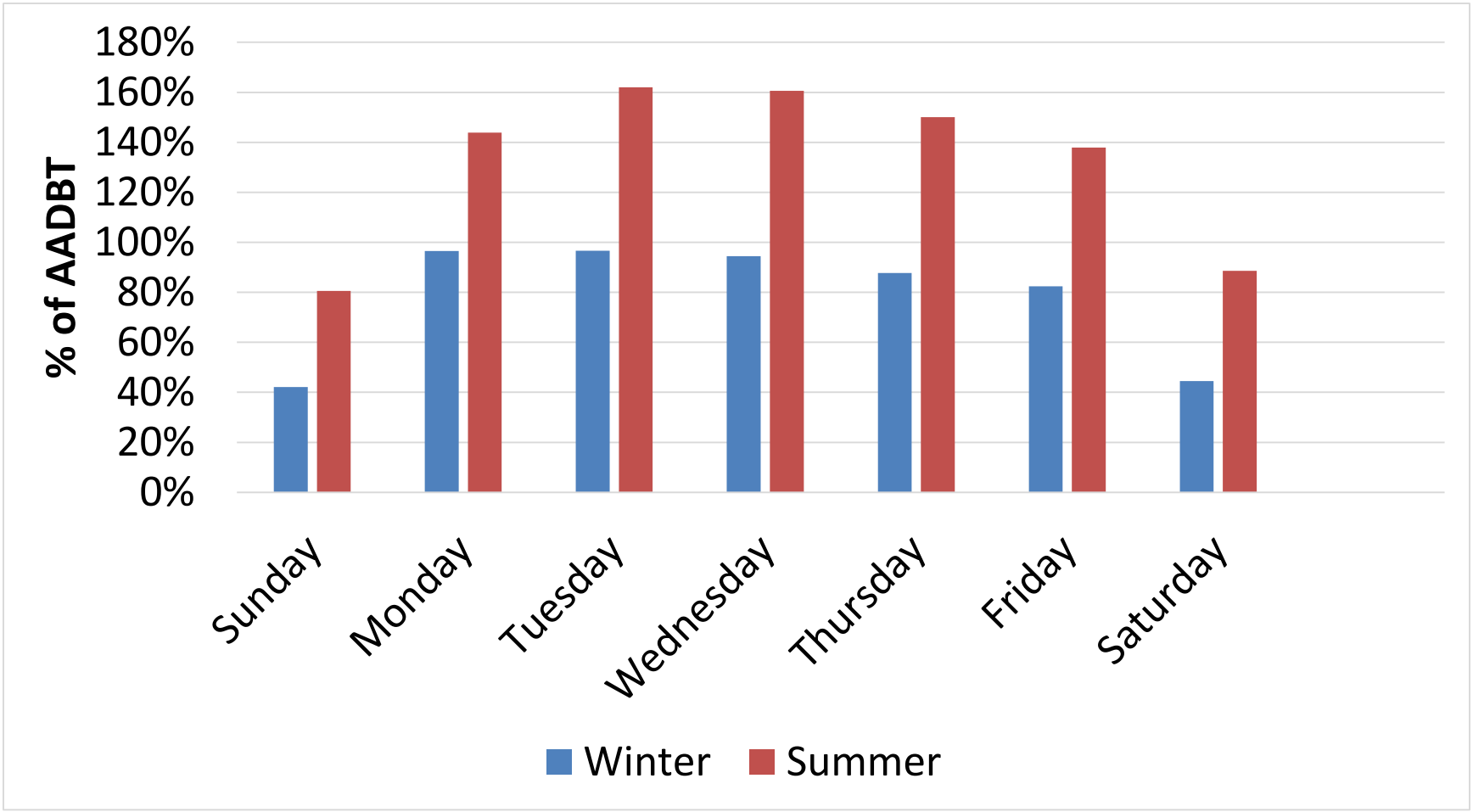
- Seattle – one year of data 2012

Fremont Bridge, Seattle

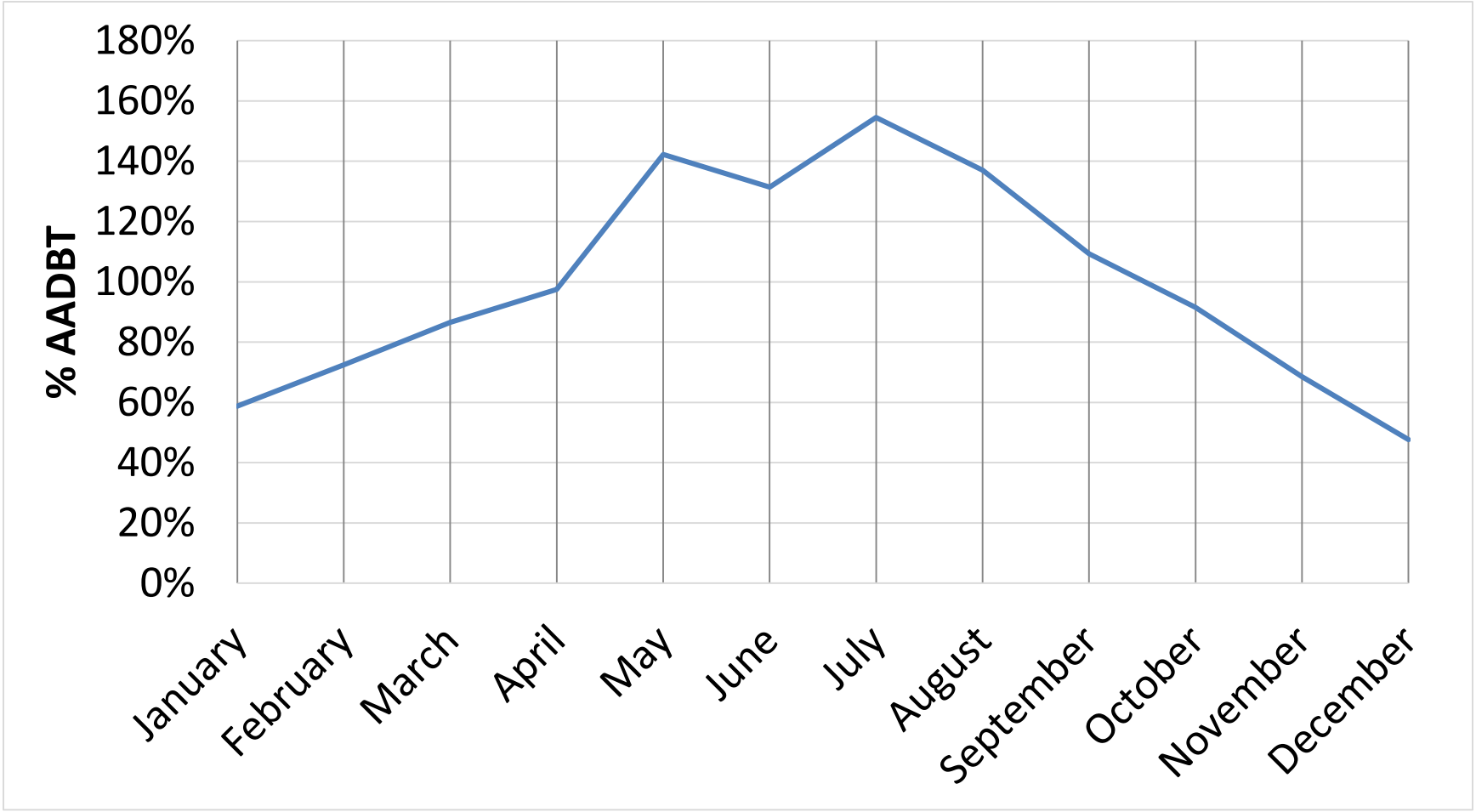


Annual Average Daily Bicycle Traffic (AADBT) = 2,461

Fremont Bridge, Seattle



Fremont Bridge, Seattle



Annual Average Daily Bicycle Traffic (AADBT) = 2,461

Factoring Method

Adapted from Traffic Monitoring Guide

$AADBT = C_{known} * M * D$

C_{known} = hourly count

M = Monthly Factor

D = Daily/Hourly Factor

Monthly Factor

December

$$M = \frac{AADBT}{MADBT} = \frac{2{,}000}{1{,}000} = 2$$

Daily counts in December are half of AADBT.

where

MADBT = Ave daily bike traffic in that month

Created Monthly Factors

Month	Monthly AADBT	Factor
January	1,448	1.7
February	1,787	1.4
March	2,132	1.2
April	2,400	1.0
May	3,502	0.7
June	3,237	0.8
July	3,806	0.6
August	3,373	0.7
September	2,691	0.9
October	2,254	1.1
November	1,688	1.5
December	1,173	2.1

Created Daily/Hourly Factors

	7-8 AM Week-day	8-9 AM Week-day	10-11 AM Week-day	11-Noon Week-day	4-5 PM Week-day	5-6 PM Week-day	6-7 PM Week-day	Noon-1 PM Satur-day	1-2 PM Satur-day
January	9.0	6.1	26.5	32.3	11.0	5.5	8.1	28.3	21.0
February	8.8	6.0	28.4	33.4	11.2	5.4	7.8	17.1	16.3
March	9.9	7.1	29.4	39.3	13.2	6.3	8.6	13.9	12.5
April	8.2	6.2	25.7	31.4	10.0	5.3	6.7	26.9	33.1
May	8.7	6.7	29.9	41.0	12.1	5.6	7.5	21.4	17.5
June	9.3	7.1	27.8	34.8	11.4	5.7	7.3	16.2	14.4
July	10.3	7.5	25.7	33.9	12.0	6.2	7.9	19.2	18.0
August	9.8	6.8	24.6	33.4	11.7	5.7	7.1	22.1	19.8
September	8.7	5.8	23.7	31.6	10.8	4.9	6.2	27.6	24.5
October	14.5	15.2	17.4	17.0	14.4	15.3	22.0	25.1	22.8
November	8.1	5.8	24.0	31.0	9.4	5.5	8.4	17.0	19.9
December	8.6	5.6	24.2	33.6	10.1	5.3	8.3	24.7	25.1

Should these be factors be applied across the state?

NO

Non-motorized Data

Volume data:

Type	Pros	Cons
Survey/travel diary	Representative sample	No facility level info
GPS	Route choice included	Usually self-selection bias
Continuous and short-term counts	Facility level	Many locations needed

Spatial Variables:

- Facility type, land use, geography
- Socio-demographics, population

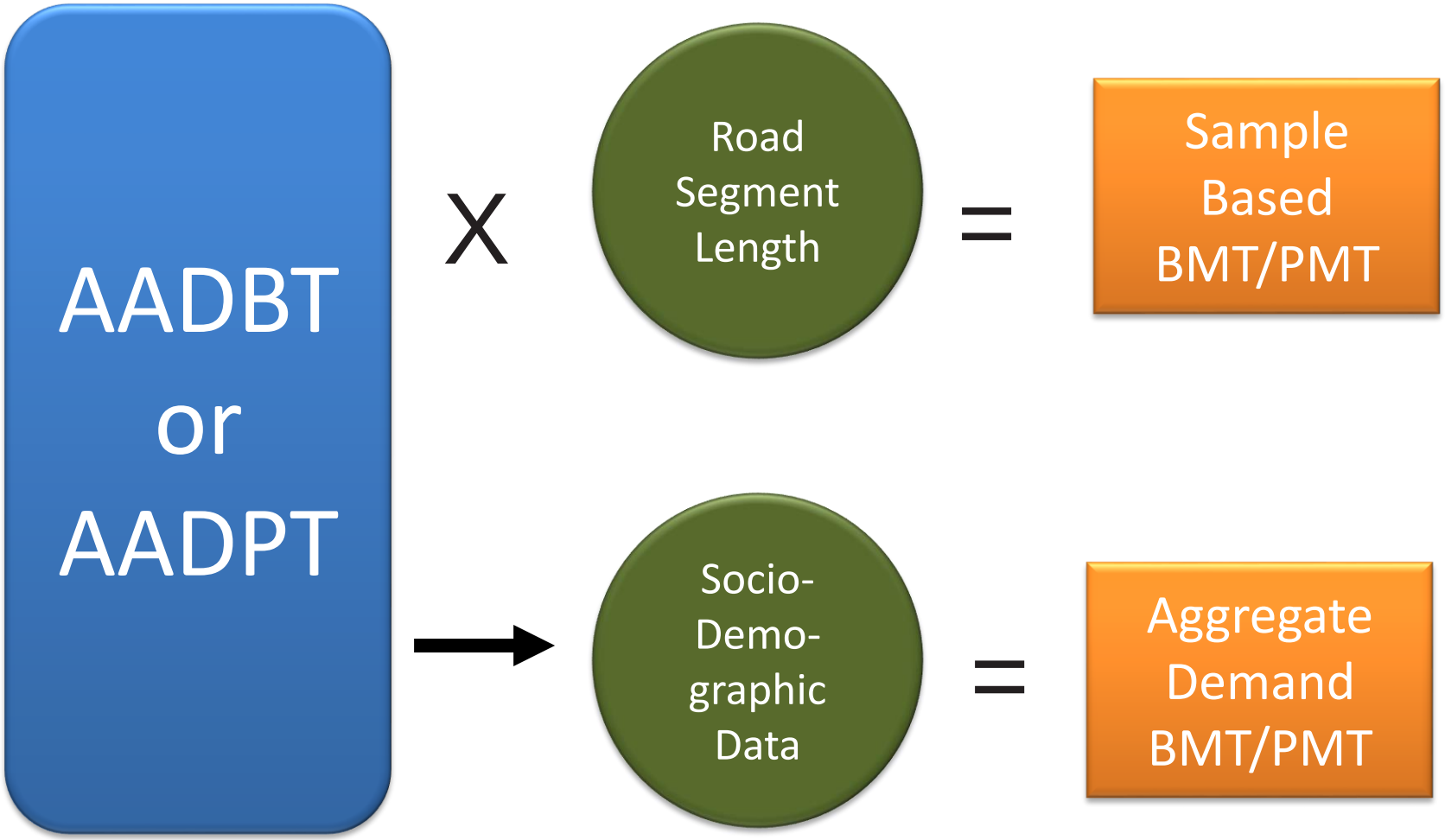
METHODS

Estimating Pedestrian and Bicycle Miles Traveled (PMT/BMT) in Washington State

Pedestrian/Bicycle Volume Estimates

- Sample-based approach
- Aggregate demand model
- Travel surveys

BMT/PMT

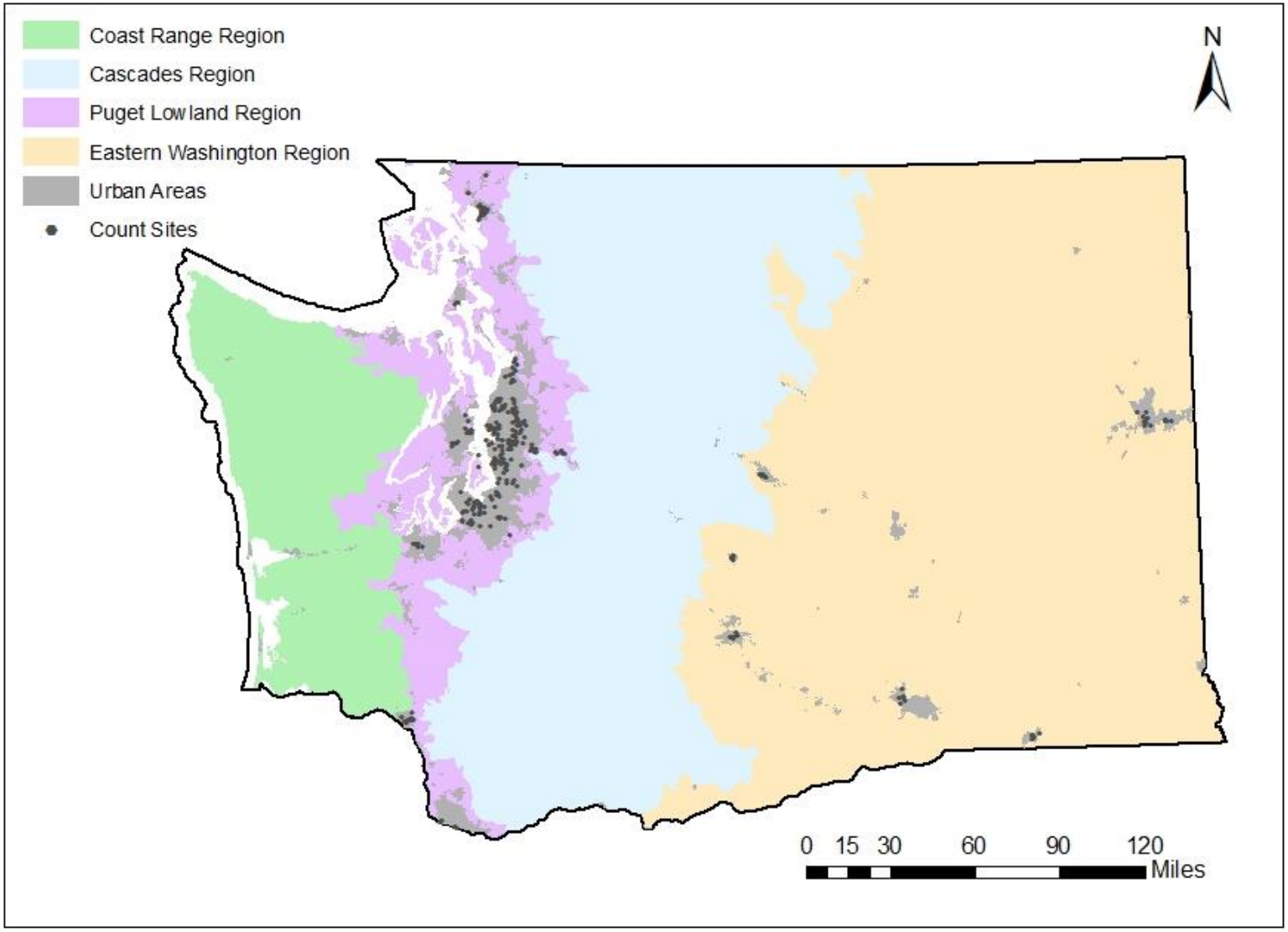

AADBT
or
AADPT
X
Road
Segment
Length
=
Sample
Based
BMT/PMT
Socio-
Demo-
graphic
Data
=
Aggregate
Demand
BMT/PMT

Sample-based Method

- Stratified Random Sample
  - Where to count?
  - Which strata (attributes) impact bike/ped volumes?

Sampling Groups

Attribute	Recommended Categories	Number of Categories
Level of urbanism	Urban Rural	2
Road or path type	Arterials & highway; Local Roads, collectors Trails in separate right-of-way	3
Geographic and climatic regions	Coast Range Puget Lowland Cascades Eastern Washington	4


Coast Range Region
Cascades Region
Puget Lowland Region
Eastern Washington Region
Urban Areas
Count Sites
N
0 15 30 60 90 120
Miles

Sample-based Method

- Groups

  4 Regions X 2 Urban/Rural X 3 Road Type=

  24 Groups
- Compute center lane miles for each
- Compute AADPT and AADBT for each.
- Compute PMT or BMT

  = Miles X AADBT X 365 days/year

Aggregate Demand Model

- Dependent Variable: AADBT and AADPT
- Independent Variables
  - Facility type: This variable has three categories.
    - Local and collector roads
    - Arterial roads and highways
    - Trail
  - On a bridge?
  - Population density
  - Age: % population age 18 to 54
  - Education: % population with a four-year degree or more
- Ordinary Least Squares Regression

National Household Travel Survey (NHTS) Method

- “Back of the envelope” method
- Uses research from Pucher et al.
- NHTS and Census Data
- Puget Sound Regional Travel Survey

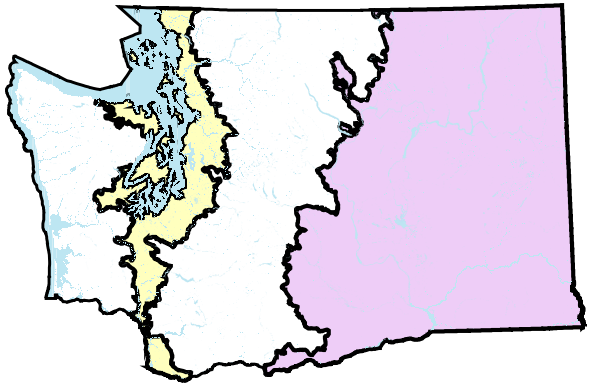
RESULTS

Sample-based Estimates

- Using the available data, PMT and BMT only estimated in 4 of 16 sampling groups.
- Trail traffic highest.
- Estimates are biased toward over estimation, since count sites were deliberately chosen at locations where bicycle and pedestrian activity tend to be high.
- This bias can be corrected in the future by randomly sampling count locations.

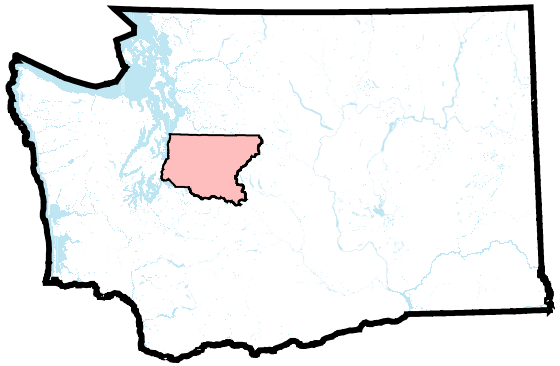
Estimates Using Count-Based Method (Millions of Miles)

Region	PMT	BMT
Puget	3,500	1,200
Eastern	1,400	300
TOTAL	4,900	1,500



Aggregate Demand Estimates

- Too data intensive to compute statewide during scope of project
- To calculate BMT and PMT statewide :
  - Associate road and trail segments throughout the state with the corresponding census tract and American Community Survey (ACS) data.
  - Apply the explanatory variables to each segment to estimate AADBT and AADPT for the segment.
  - Multiply AADBT and AADPT by the length of the segment.
  - Sum all of the segments and multiply by 365.

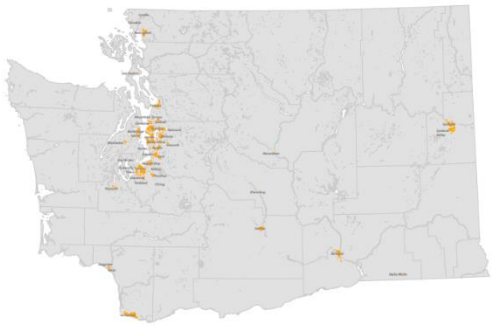


NHTS Estimates

- 415 households surveyed in Washington State
- 891 individuals in the 2009 NHTS
- 96 (11%) reported making at least one bike trip in the past week
- 645 individuals (72%) reported making at least one walking trip in the past week
- Only 2 and 9 individuals biked and walked to work in the past week, respectively
- Necessary to use nationwide data in order to produce an acceptable sample size of bicyclists and walkers.

Statewide Estimates Using National Survey Method (in Millions of Miles)

	PMT	BMT
Estimate	700	200



National Household Travel Survey as reported by Pucher et al. 2011 (Pucher, Buehler et al. 2011).

King County Comparison

Annual PMT and BMT for King County within the Puget Lowlands (Millions of Miles)

Method	Lower PMT	PMT	Upper PMT	Lower BMT	BMT	Upper BMT
National Survey Data	190	200	210	40	45	50
Count Based Method (All Puget Sites)	1,240	1,900	2,560	540	710	880
Count Based Method (All Puget Sites Trails and Local Separated)	1,160	1,800	2,430	370	510	650
Count Based Method (King County Sites Only)	1,290	2,190	3,090	770	1,050	1,330
Count Based Method (Trails and Local Separated)	1,430	2,360	3,280	460	690	930
Aggregate Demand Model	100	560	3,000	50	220	910

57,000 Million Miles VMT in 2011 for WA (FHWA)

State-wide comparison

57,000 Million Miles VMT in 2011 for WA (FHWA)

Sample-based Method

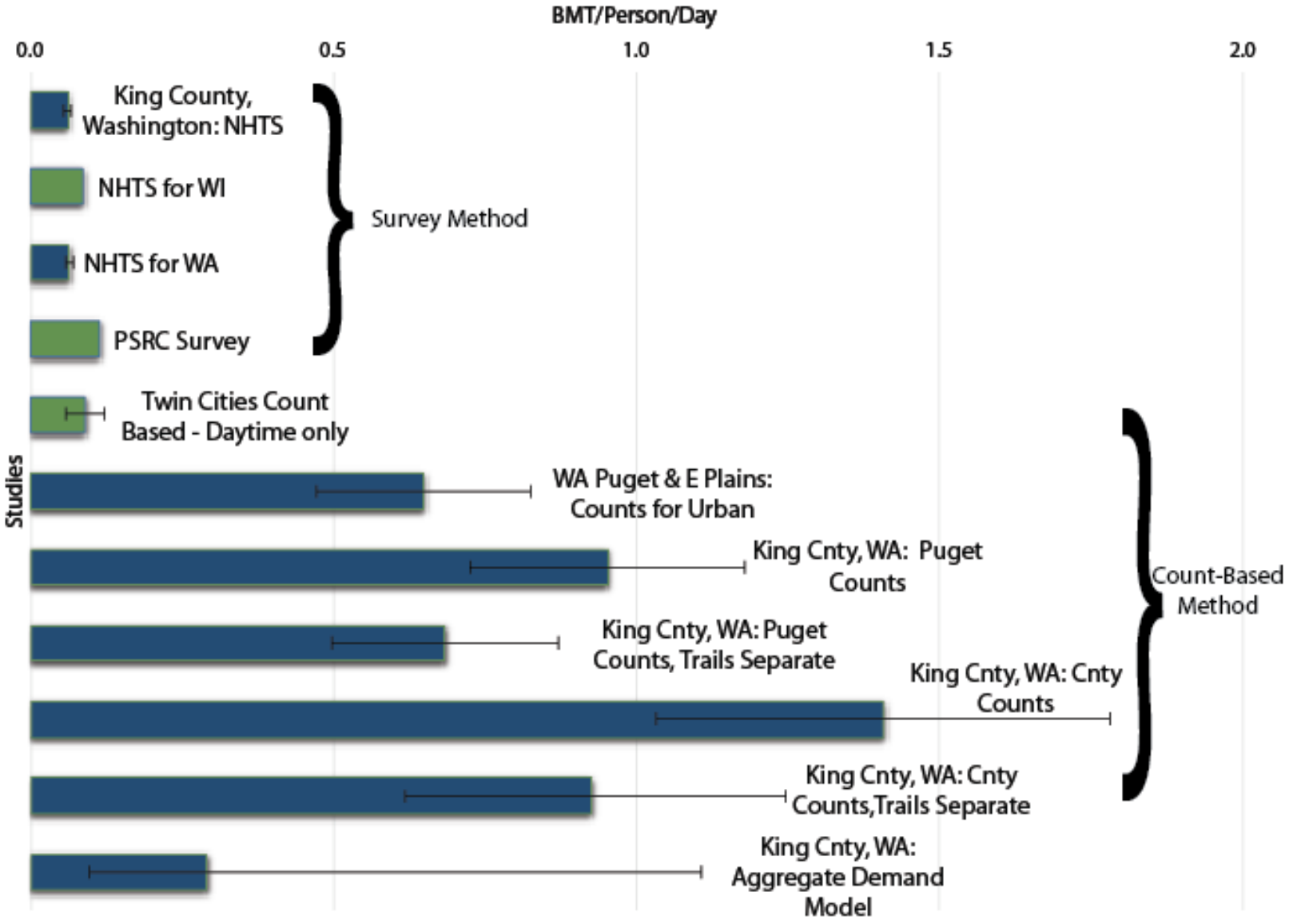
Sum of Puget Lowland and Eastern Washington

4,900 Million Miles PMT; 1,500 Million Miles BMT

National Survey Method

700 Million Miles PMT; 200 Million Miles BMT

BMT Methods Comparison Across Studies



CONCLUSIONS & RECOMMENDATIONS

Conclusions

Approach	Pros	Cons
Sample-based	Data are at the facility level.	- Short duration counts tend to be biased towards high count locations. - It is harder to sample pedestrian locations
Aggregate demand model	More accurate estimate of PMT and BMT. Especially useful for pedestrian travel	Difficult to do at the state level.
Travel survey	Expanding existing dataset is easier than creating new dataset.	Data are not at the facility level

Bikes

Pedestrians

FACILITY LEVEL

STATE LEVEL

Recommendation: Better Data Needed

- Improve count program
  - Expand
  - Remove bias
- Improve travel survey
  - Larger sample
- Consider integrating other data sources
  - GPS apps

Recommendation: Better Data Needed

Permanent Counters:

- Expand program to include diverse areas
  - Rural areas and mountain regions
  - Paths and roads
- Choose sites selectively
  - Works for equipment
  - Moderate to high volumes

- Count bikes and pedestrians separately
- Install at least 1 permanent counter per region and facility type (ideally increasing to at least 7 per factor group)

Recommendation : Better Data Needed

- Permanent Counters
  - Document
    - equipment malfunction
    - Special events
  - Take photos of site with context
  - Validate counting equipment
    - *And after you recalibrate, validate again!*

For more info check out NCHRP 797

Recommendation: Better Data Needed

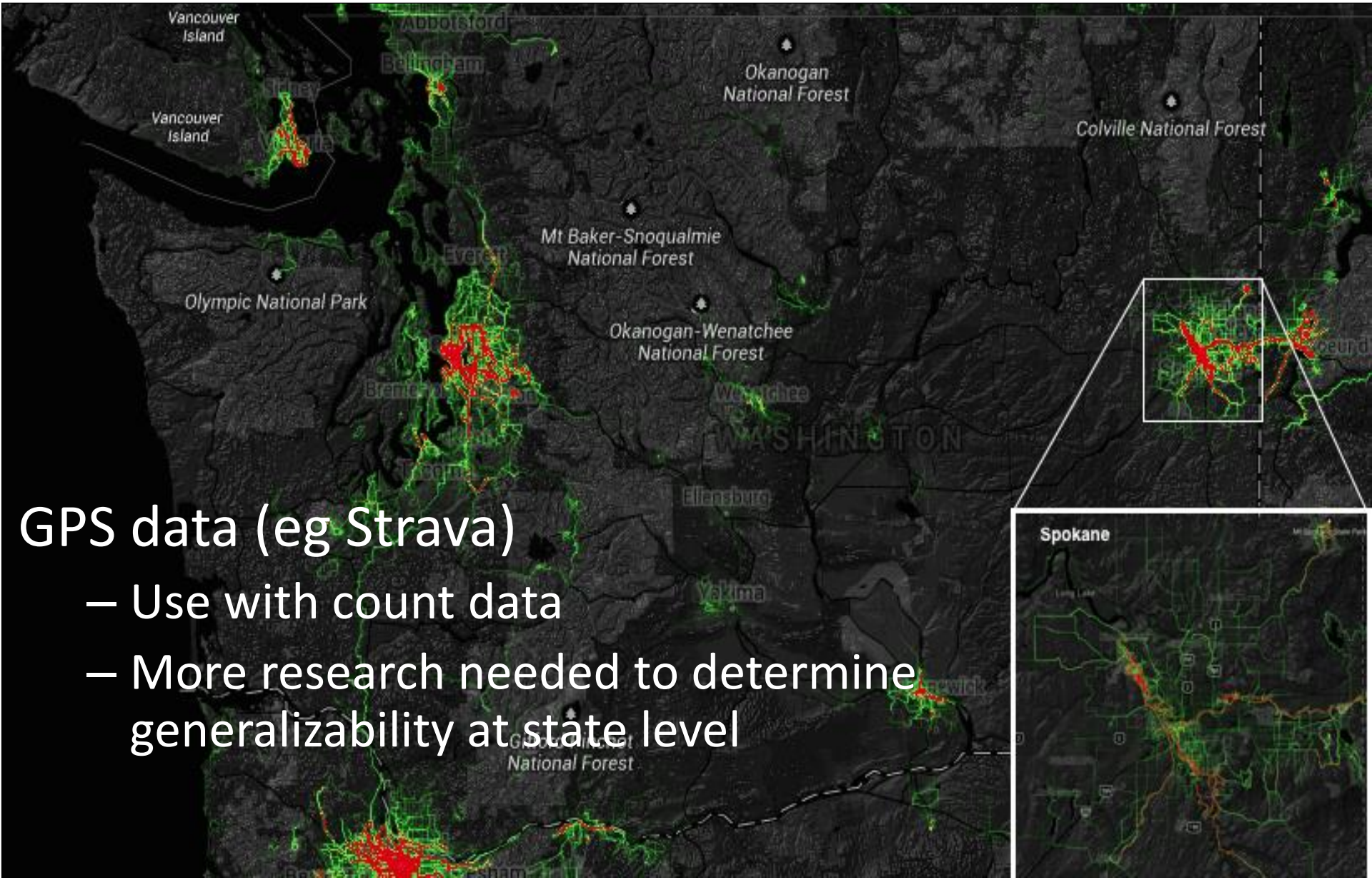
Short Duration Counters:

- Select short duration sites using random stratified sampling.
- At least 150 short duration count sites per group.
- Ideally, 7 days per site (shorter manual counts still worthwhile).
- Count bikes and pedestrians separately.

Recommendation: Better Data Needed

- Travel survey (for state level)
  - Oversample NHTS or
  - Establish separate statewide household travel survey.

Recommendation: Better Data Needed

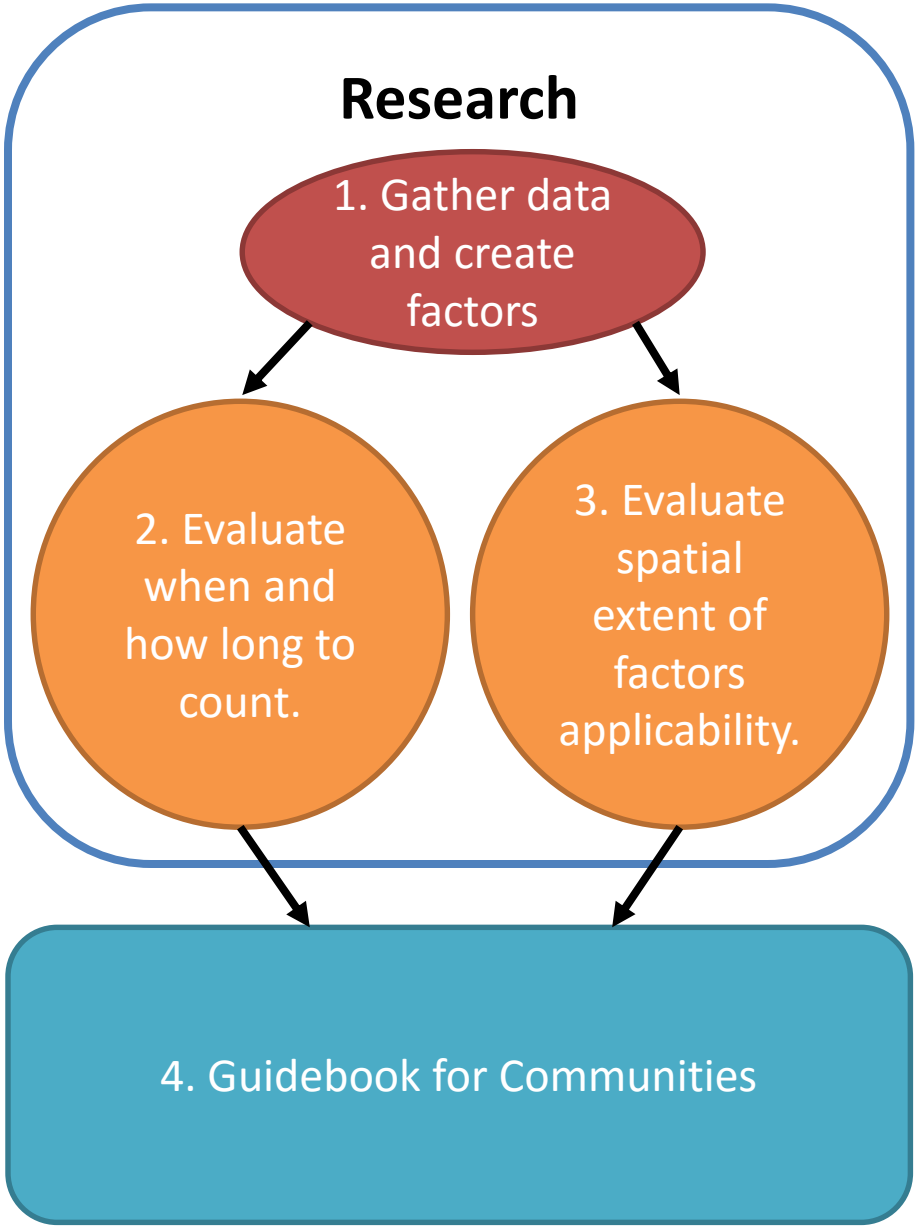


GPS data (eg Strava)

- Use with count data
- More research needed to determine generalizability at state level

Next Steps

- Guidebook for communities
- Collaboration with Mike Lowry, PhD, University of Idaho



WSDOT

Discussion & Questions

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References

- NCHRP 797
  http://www.trb.org/Publications/Blurbs/171973.aspx
- Traffic Monitoring Guide 2016
  http://www.trb.org/Publications/Blurbs/171973.aspx
- Exploring Pedestrian Counting Procedures
  http://www.trb.org/Publications/Blurbs/171973.aspx

Websites

- https://www.pdx.edu/ibpi/resources-0
- http://www.pedbikeinfo.org/